CFD helps optimize yacht design process

MARIN's day-in-day-out experience gained through more than a 1,000 projects has allowed the institute to build up a vast knowledge of CFD applications. As well as the more complex analysis available that is continuously under development at MARIN, here Report presents the more "standard" CFD use, which is as popular as ever.

Although CFD started as a complex technology with huge potential it is now at the heart of our engineering, complementing and in some cases replacing, model testing. Certainly it provides a valuable insight into the complexity of hydromechanics with only a few "smart" keystrokes. Combining the basic potential flow technology and (unsteady) RANS methods, the hull form, appendages and their alignment can be evaluated and optimised in a cost-effective and accurate way. This ready availability fits perfectly in (pre-contract) design work. This is especially important when clients may have a pass-through time of only a few days or a couple of weeks.

It is of utmost importance that strengths should be utilised and there must be an awareness of the shortcomings of these tools in any successful project. Experience gained through numerous projects ensures a sensible use of CFD. MARIN's focus on validation is addressed in other articles in this issue of Report.

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Explorer yacht The project illustrated here concerns a 39 m Explorer yacht to be built at Alloy Yachts in Auckland, New Zealand. The yacht was designed by René van der Velden for a private owner.

In close cooperation with the naval architect the streamlines and dynamic water surface are easily integrated in 3D models. In this way, the impact of the flow on appendage alignment and on submergence of exhausts and interaction with fenders and anchor pockets can be verified. Some sample applications are illustrated here as conducted for René van der Velden's yacht design.

Reading the streamlines into their 3D model, (see renderings), the bilge keel location, alignment and mutual location with respect to the fin stabilisers were selected to ensure optimum roll damping. This amongst other alignments and a verification of the hull form was conducted parallel to the engineering process with a pass-through time of a couple of weeks.

With more than 1,000 commercial CFD projects under our belt, MARIN is the ideal partner to assist in the design process.

1998

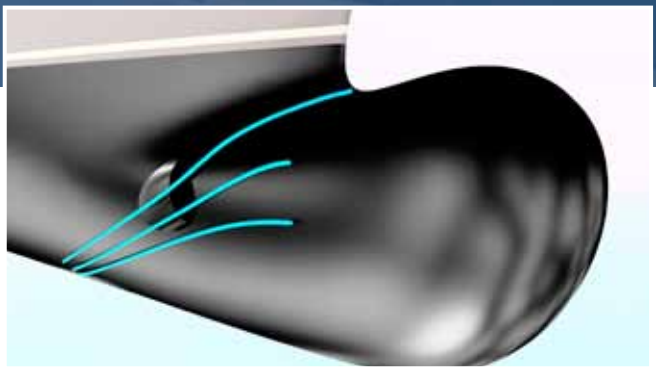
1st FPSO Forum

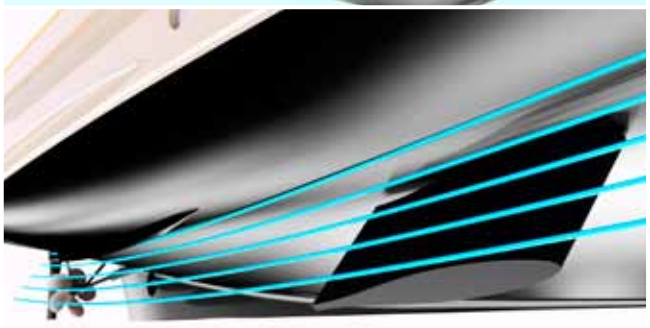
1998

Opening MARIN Inc. in Houston, USA

Visit us at the Monaco Yacht Show (September 22-25) to further discuss how CFD can help to optimize your yacht design process. Stand QS75

Courtesy René van der Velden Yacht Design





3D model René van der Velden, streamlines in blue

Several applications

Streamlines around the bow tunnel can be used to judge the necessity and orientation of a scallop, grid or spoiler. The flow lines around the bilge can be rather speed-dependent, especially when sailing at high Froude numbers. The streamlines' speed dependency are to be taken into account when placing the bilge keels and determining the neutral angle of fin stabilisers. The speed-dependent neutral orientation of fin stabilisers may be taken account in the control system on the bridge. In certain cases it is relevant to determine the interactions between the bilge keels and fin stabilisers or other appendages with a full viscous CFD analysis in order to avoid degradation of roll damping and/or noise and vibrations sources for instance.

Shaft brackets give an undesired wake peak in the propeller plane. This may lead to undesired noise and erosion if the alignment is not perfect, especially when sailing at higher speeds and propeller loading. The minimum drag orientation or twist of the streamlined brackets can be determined when taking the contribution of the propeller action into account. On the other hand, the so-called nominal wake field can be derived and this is an input for propeller design. A coupling of MARIN's PROCAL and Excalibur software gives our specialists the functionality to custom-design a propeller while controlling cavitation and pressure pulses.

2000

Model tests for 'Queen Mary II' with 20 MW pod

2001

Opening new Offshore Basin and Seakeeping & Manoeuvring Basin